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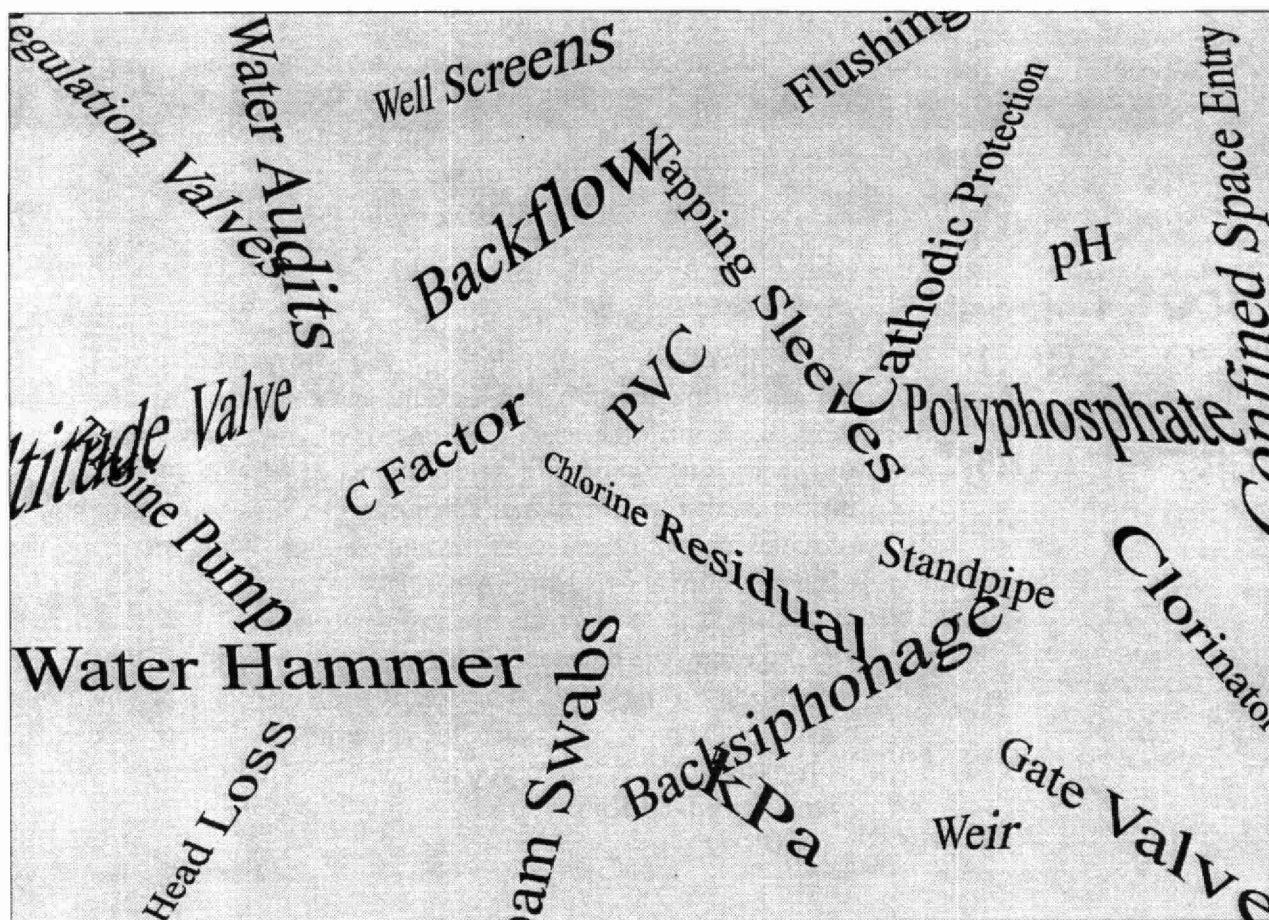
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# Water Distribution Operator Need-To-Know

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October 1996

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ABC



Ontario

Ministry of Environment  
and Energy

FEB 19 1997

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## FORWARD

**T**his guide was created to help trainers, supervisors and operators determine what topics to review while studying for operator certification exams. The guide breaks each exam into numerous topics and indicates the level of knowledge required for each exam.

In 1995-96 a committee of experienced operators and supervisors reviewed the Associate of Boards of Certification standard North American "Need-To-Know". From this review several revisions were made to reflect Ontario's operational needs. From the new, revised "Need-To-Know" the committee developed new certification exams.

The following individuals were members of the Water Distribution Exam Review Committee:

Bob Brown - Ontario Clean Water Agency  
Stan Curylo - Region of Peel  
John Este - Town of Schreiber  
Sal Gelsomino - Region of Ottawa-Carleton  
Don Giberson - City of London  
Brian Gildner - Ministry of Environment and Energy  
Jamie Hennigar - Ontario Clean Water Agency  
Butch Hummel I - Region of Hamilton-Wentworth  
Butch Voisin - City of Waterloo  
Peter Williams - Town of Richmond Hill

## ABOUT THE ASSOCIATION OF BOARDS OF CERTIFICATION

**T**he Association of Boards of Certification (ABC) has been involved in developing water and wastewater operator certification programs, exams and support materials since 1966. ABC is a North American organization with members in 48 states and 9 provinces. Ontario became a full member of ABC in 1986 to support the introduction of the province's voluntary certification program. ABC provides the province with testing services, support materials and expertise from across North America.

Ontario exams are developed with assistance from the ABC and are fully recognized by the ABC. For details on reciprocity of Ontario exams outside of the province, contact the authority responsible for certification in the province/state which you are interested. Be sure to forward a copy of this "Need-To-Know".

## INTRODUCTION

**B**efore writing an exam, operators should be aware how each exam is developed. By understanding how the exams are made, it will be easier to study.

The first point to remember is that the exams are cumulative. This means that the knowledge required at a lower class is also required at higher classes. For example, a Class IV operator must know all Class IV topics as well as the Class I, II, and III topics. Generally, questions on a Class IV exam will be more difficult than questions on the same topic on lower classes.

Although the exams are cumulative, each exam will emphasize different topics. For example in the "Processes Module" of Water Distribution exams, Class I will emphasize the basic principles of the conveyance of water; Class II will focus on distribution/disinfection of well water; Class III and IV on pressure control and storage. Since each exam emphasizes different topics an operator is not allowed to 'skip' exam levels (i.e. go from a Class I to a Class IV without first going through Class II and III).

**D**eveloping fair exams for distribution operators is a challenge in a province containing relatively simple, small facilities along side large complex ones. Technologies which may be common in one size of facility may be absent in another. However, an operator who holds any Class of Water Distribution licence may operate in any water distribution system in the province. For this reason even at a Class I level operators will be expected to have a basic level of understanding or awareness in some of the common advanced processes or technologies (i.e. storage). Therefore, some of the questions on the exam may cover processes or technologies not used in the operator's facility. Although the question may not apply to your facility, it will be relevant for many other operators in the province.

The exams which are written in Ontario are similar to those in other provinces and states. Ontario uses the same format (multiple choice), same length (100 questions) and the same source of questions (the ABC question bank). By keeping the exams similar to the industry standard, the marks obtained by Ontario operators will be more readily accepted in other provinces and states.

## HOW TO USE THE "NEED-TO- KNOW"

**T**he "Need-to-Know" is designed as an aid for operators and supervisors. It contains three sections to help users determine the topics and level of training required to meet the requirements of certification examinations. The three sections are:

- \* **"General Exam Modules"**, provides a broad overview of the exams (*page 3*).
- \* **"Detailed Topic Breakdown"**, provides a detailed breakdown of the topics covered on each exam. It also provides an indication of the level of knowledge required for each topic (*pages 6-8*).
- \* **"Task Analysis"**, provides a further definition of the tasks and knowledge required for each topic at each Class (*pages 13-21*).

Together these three sections will help guide the operator while studying. For more information on study materials and course offerings refer to the booklet entitled **"Education & Certification Resource Guide for Water & Wastewater Utility Operators"**, available free from the Ministry of Environment and Energy's Certification Office.

## GENERAL EXAM MODULES

**E**very exam is divided into 4 different modules. Each module is further divided into topics. Every question on the exam will fit into one of the topics. The 4 different modules are:

**General Module:** This module includes basic background knowledge and skills which are required by an operator to perform his/her duties. Some of the skills and knowledge may be obtained prior to becoming an operator, in school or at other work experiences. Others will be specific to the water/wastewater industry. This knowledge is applied on a routine basis by the operator to complete his/her job (i.e. arithmetic calculation of chemical feed rates).

**Support Systems Module:** This module includes the equipment/materials necessary to distribute safe water. Pumps, motors and engines are some of the equipment covered. The module also includes piping, fittings, valves, joints, measuring systems and control systems. Operators will be expected to be familiar with the operation and troubleshooting aspects of this equipment. Detailed maintenance of the equipment is not covered in the exam.

**Processes Module:** This module focuses on the processes involved in water distribution. This module is the main focus for the exams, requiring the operator to demonstrate knowledge in the day to day operation of the processes at a facility. Included in this module are equipment specific to processes (i.e. chlorinators, wells, pumping stations). Operators will be expected to know how to operate this equipment, its relationship to the overall treatment process and basic troubleshooting. Detailed maintenance of this equipment is beyond the scope of the exams.

**Administration Module:** This module covers administrative functions which support the on-going operation of a facility. Depending on the class of exam, operators will be expected to demonstrate knowledge and understanding of supervision, finance, communication, site security, information systems and emergency response procedures.

Below is a table indicating the percentage of questions in each of the modules.

| PERCENTAGE BREAKDOWN FOR EACH EXAM MODULE           |              |               |                |               |
|-----------------------------------------------------|--------------|---------------|----------------|---------------|
|                                                     | CLASS I EXAM | CLASS II EXAM | CLASS III EXAM | CLASS IV EXAM |
| GENERAL MODULE                                      |              |               |                |               |
| GENERAL MATH                                        | 10%          | 5%            | 0%             | 0%            |
| SAFETY                                              | 13%          | 8%            | 5%             | 5%            |
| APPLIED SCIENCE                                     | 10%          | 10%           | 5%             | 5%            |
| SUPPORT SYSTEMS MODULE                              | 22%          | 17%           | 10%            | 10%           |
| PROCESS MODULE                                      | 35%          | 50%           | 60%            | 60%           |
| ADMINISTRATION MODULE                               |              |               |                |               |
| MANAGEMENT                                          | 3%           | 5%            | 10%            | 10%           |
| ADMINISTRATION                                      | 7%           | 5%            | 10%            | 10%           |
| TOTAL:                                              | 100%         | 100%          | 100%           | 100%          |
| PERCENT QUESTIONS REQUIRING ARITHMETIC CALCULATIONS |              |               |                |               |
| CALCULATING                                         | 7%           | 8%            | 10%            | 12%           |
| NON-CALCULATING                                     | 93%          | 92%           | 90%            | 88%           |

## DETAILED TOPIC BREAKDOWN

**T**he above table also indicates the number of questions which require arithmetic calculations. These questions will be scattered throughout the various modules. In Class I and II exams most of the questions will be in the General Module (General Math Section). In higher Classes the questions will be in the Support Systems Module (i.e. pump, chemical feeder questions), the Process Module (i.e., conveyance, disinfection questions), or the Administration Module (i.e. finance questions). Generally the Class III and IV questions which require calculations are more difficult. These questions require problem solving abilities in addition to arithmetic skills.

**T**he *Detailed Topic Breakdown* lists the skills, knowledge, equipment, processes, laboratory analysis, and administrative components of the operator's job. It is a table containing all of the examination topics. Each topic is also given a 'mastery rating'. This rating will give operators some indication of the level of difficulty for each topic. The mastery ratings are:

- Basic:** Operators must understand the importance of the topic; and how it relates to the overall operation of the system. Basic terminology and concepts are covered.
- Intermediate:** Operators must have working or functional knowledge/skill in the topic.
- Advanced:** Operators must be able to evaluate the topic and fully understand the interaction of the topic with the overall operation of the system.

*Intermediate* levels include all *basic* levels. *Advanced* levels include all *intermediate* and *basic* levels.

Most of the topics in the *Detailed Topic Breakdown* have footnotes. On pages 11-13 the footnotes provide a more detailed description of the topic. Further detail is provided in the *Task Analysis*.

## TASK ANALYSIS

**T**he *Task Analysis* listings, which follows the *Detailed Topic Breakdown*, lists the performance objectives for each topic. The performance objectives are broken down into *Basic*, *Intermediate* and *Advanced* levels. These are the same levels of mastery which are listed in the *Detailed Topic Breakdown*. The *Task Analysis* provides operators with greater detail on the learning objectives for each topic.

**Using the *Detailed Topic Breakdown* and the *Task Analysis* listings:**

**T**he objectives listed in the *Task Analysis* are used in combination with the topics in the *Detailed Topic Breakdown*. These will help to define what an operator needs to know in each topic. The *Detailed Topic Breakdown* indicates the level of mastery of the exam topics. The *Task Analysis* state performance objectives for each topic by the difficulty level (*Basic*, *Intermediate* and *Advanced*).

To successfully complete an ABC examination, an operator must demonstrate knowledge of the *Task Analysis* performance objectives for each *Detailed Topic Breakdown* topic according to the rating assigned to the topic. Following is an example of how to use the *Detailed Topic Breakdown* and *Task Analysis*.

**A**n operator would like to know what information is required to pass the topic called Hydraulic Concepts on a Class I exam.

1. First the operators should look in the *Detailed Topic Breakdown* (the table starting on page 6) for the topic entitled "Hydraulic Concepts".
2. For a Class I exam the rating assigned to Hydraulic Concepts is *Intermediate*.
3. The operator must know how to perform all *Intermediate* tasks for Hydraulic Concepts.
4. Next, the operator observes that a number <sup>6</sup> appears after the topic heading. This indicates that a more detailed description of the topic is given at the end of the *Detailed Topic Breakdown*. The operator turns to page 11 to read the description.
5. The operator now refers to the *Task Analysis* section.
6. In the left column of the General Module (page 13) it states that:  
"A: The operator must complete the following performance objectives as indicated":
7. Under Hydraulic Concepts (page 14-15) the *Intermediate* objectives are:
  - 6.3 Calculate pumping head, pressure head, static head
  - 6.4 Using hydraulic concepts and terms explain how a pump functions
8. The operator must also meet all of the objectives stated under the *Basic* level:
  - 6.1 Define basic hydraulic concepts (head, pressure, rate of flow).
  - 6.2 Explain the movement and properties of liquid under pressure.
9. The operator must be able to meet all of the stated objectives for the topic.

| ONTARIO WATER DISTRIBUTION EXAM<br>DETAILED TOPIC BREAKDOWN |                                                                   |                                       |              |              |              |          |
|-------------------------------------------------------------|-------------------------------------------------------------------|---------------------------------------|--------------|--------------|--------------|----------|
| GENERAL MODULE                                              |                                                                   | Class I                               | Class II     | Class III    | Class IV     |          |
| 100                                                         | General Math Section                                              |                                       |              |              |              |          |
| 101                                                         |                                                                   | Basic & Applied Math <sup>1</sup>     | Intermediate | Advanced     | Advanced     | Advanced |
| 102                                                         |                                                                   | Units of Expression <sup>2</sup>      | Advanced     | Advanced     | Advanced     | Advanced |
| 110                                                         | Applied Science Section                                           |                                       |              |              |              |          |
| 111                                                         |                                                                   | Basic & Applied Science <sup>3</sup>  | Basic        | Intermediate | Advanced     | Advanced |
| 112                                                         |                                                                   | Public Health Principles <sup>4</sup> | Intermediate | Advanced     | Advanced     | Advanced |
| 113                                                         |                                                                   | Electrical Concepts <sup>5</sup>      | Basic        | Intermediate | Intermediate | Advanced |
| 114                                                         |                                                                   | Hydraulic Concepts <sup>6</sup>       | Intermediate | Advanced     | Advanced     | Advanced |
| 115                                                         |                                                                   | Maps & Plans <sup>7</sup>             | Intermediate | Intermediate | Advanced     | Advanced |
| 120                                                         | Safety Section                                                    |                                       |              |              |              |          |
| 121                                                         |                                                                   | Safety Procedures <sup>8</sup>        | Advanced     | Advanced     | Advanced     | Advanced |
| 122                                                         |                                                                   | Safety Equipment <sup>9</sup>         | Advanced     | Advanced     | Advanced     | Advanced |
| SUPPORT SYSTEMS MODULE                                      |                                                                   | Class I                               | Class II     | Class III    | Class IV     |          |
| 201                                                         | Electrical Controls <sup>10</sup> /<br>Transformers/Battery Banks |                                       | Basic        | Intermediate | Advanced     | Advanced |
| 202                                                         | Motors <sup>11</sup> / Drives <sup>12</sup>                       |                                       | Intermediate | Advanced     | Advanced     | Advanced |
| 203                                                         | Pumps                                                             |                                       |              |              |              |          |
|                                                             |                                                                   | Centrifugal                           | Basic        | Intermediate | Advanced     | Advanced |
|                                                             |                                                                   | Positive Displacement <sup>13</sup>   | Basic        | Intermediate | Advanced     | Advanced |
|                                                             |                                                                   | Turbine                               | Basic        | Intermediate | Advanced     | Advanced |
|                                                             |                                                                   | Metering                              | Intermediate | Advanced     | Advanced     | Advanced |
| 204                                                         | Generators <sup>14</sup>                                          |                                       | Intermediate | Advanced     | Advanced     | Advanced |
| 205                                                         | Engines <sup>15</sup>                                             |                                       | Intermediate | Advanced     | Advanced     | Advanced |
| 206                                                         | Pipes                                                             |                                       | Advanced     | Advanced     | Advanced     | Advanced |
| 207                                                         | Joints <sup>16</sup>                                              |                                       | Advanced     | Advanced     | Advanced     | Advanced |
| 208                                                         | Valves <sup>17</sup>                                              |                                       | Advanced     | Advanced     | Advanced     | Advanced |
| 209                                                         | Fittings <sup>18</sup>                                            |                                       | Advanced     | Advanced     | Advanced     | Advanced |
| 210                                                         | Cathodic Protection Devices <sup>19</sup>                         |                                       | Basic        | Intermediate | Advanced     | Advanced |
| 211                                                         | Hydrants                                                          |                                       | Intermediate | Advanced     | Advanced     | Advanced |

| SUPPORT SYSTEMS MODULE |                                                              | Class I      | Class II     | Class III    | Class IV     |
|------------------------|--------------------------------------------------------------|--------------|--------------|--------------|--------------|
| 212                    | Measuring & Control Systems <sup>20</sup>                    | Basic        | Intermediate | Advanced     | Advanced     |
| 213                    | Cross-Connection & Backflow                                  | Advanced     | Advanced     | Advanced     | Advanced     |
| PROCESSES MODULE       |                                                              | Class I      | Class II     | Class III    | Class IV     |
| 301                    | Sources & Characteristics <sup>21</sup>                      | Basic        | Intermediate | Advanced     | Advanced     |
| 302                    | Quality Control & Assurance <sup>22</sup>                    | Advanced     | Advanced     | Advanced     | Advanced     |
| 303                    | Compliance <sup>23</sup>                                     | Advanced     | Advanced     | Advanced     | Advanced     |
| 304                    | Conveyance <sup>24</sup>                                     | Intermediate | Advanced     | Advanced     | Advanced     |
| 305                    | Pressure Control <sup>25</sup>                               | Basic        | Intermediate | Advanced     | Advanced     |
| 306                    | Storage <sup>26</sup>                                        | Basic        | Intermediate | Advanced     | Advanced     |
| 307                    | Corrosion Control <sup>27</sup>                              | Basic        | Intermediate | Advanced     | Advanced     |
| 308                    | Metering <sup>28</sup>                                       | Intermediate | Advanced     | Advanced     | Advanced     |
| 309                    | Leak Detection <sup>29</sup>                                 | Basic        | Intermediate | Advanced     | Advanced     |
| 310                    | Evacuation & Repair <sup>30</sup>                            | Basic        | Basic        | Intermediate | Intermediate |
| 311                    | Repair Inspection <sup>31</sup>                              | Basic        | Intermediate | Advanced     | Advanced     |
| 312                    | Temporary Service <sup>32</sup>                              | Intermediate | Intermediate | Advanced     | Advanced     |
| 313                    | Fire Flow <sup>33</sup>                                      | Basic        | Intermediate | Advanced     | Advanced     |
| 314                    | Swabbing                                                     | Basic        | Basic        | Intermediate | Intermediate |
| 315                    | Flushing Systems                                             | Intermediate | Advanced     | Advanced     | Advanced     |
| 316                    | Well Operation <sup>34</sup>                                 |              | Advanced     | Advanced     | Advanced     |
| 317                    | Chlorination - Wells <sup>35</sup>                           |              | Advanced     | Advanced     | Advanced     |
| 318                    | Chlorination - Pipe Repair <sup>36</sup>                     | Advanced     | Advanced     | Advanced     | Advanced     |
| 319                    | Thawing <sup>37</sup>                                        | Intermediate | Intermediate | Advanced     | Advanced     |
| 320                    | Sampling <sup>38</sup>                                       | Intermediate | Intermediate | Advanced     | Advanced     |
| 321                    | Testing (Chlorine residual/pH/<br>Temperature) <sup>39</sup> | Basic        | Intermediate | Advanced     | Advanced     |

| ADMINISTRATION MODULE |                                      | Class I      | Class II     | Class III    | Class IV |
|-----------------------|--------------------------------------|--------------|--------------|--------------|----------|
| 410                   | Management                           |              |              |              |          |
| 411                   | Planning <sup>40</sup>               | Basic        | Intermediate | Advanced     | Advanced |
| 412                   | Personnel <sup>41</sup>              | Basic        | Basic        | Intermediate | Advanced |
| 413                   | Finances <sup>42</sup>               | Basic        | Intermediate | Advanced     | Advanced |
| 420                   | Administration                       |              |              |              |          |
| 421                   | Maintenance Management <sup>43</sup> | Basic        | Intermediate | Advanced     | Advanced |
| 422                   | Information <sup>44</sup>            | Basic        | Intermediate | Advanced     | Advanced |
| 423                   | Emergency Response <sup>45</sup>     | Basic        | Intermediate | Advanced     | Advanced |
| 424                   | Public Relations <sup>46</sup>       | Intermediate | Advanced     | Advanced     | Advanced |
| 425                   | Security <sup>47</sup>               | Basic        | Intermediate | Advanced     | Advanced |

**I**n each exam, certain topics in the Processes Module are emphasized. In the table below the main topics for each class of exam are given. Only topics with at least 2 questions are included. The topics are listed in order of importance. For example on a Class 1 exam there are more questions on Conveyance than questions dealing with Quality Control knowledge. Likewise there are more questions on Repair Inspection than there are on Flushing.

| PROCESSES MODULE - PRIORITY TOPICS                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                          |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                                                                                                                            | CLASS I                                                                                                                                                                                                                                                                                                      | CLASS II                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | CLASS III                                                                                                                                                                                                                                                                                                                                                                                                                                                            | CLASS IV                                                                                                                                                                                                                                                                                                                                                 |
| <b>Hi</b><br><br>Number of Questions<br><br><b>Low</b> | <ul style="list-style-type: none"> <li>* Conveyance</li> <li>* QA/QC</li> <li>* Repair Inspection</li> <li>* Flushing</li> <li>* Sources &amp; Characteristics</li> <li>* Compliance</li> <li>* Corrosion Control</li> <li>* Leak Detection</li> <li>* Excavation &amp; Repair</li> <li>* Thawing</li> </ul> | <ul style="list-style-type: none"> <li>* Well Operation/ Disinfection</li> <li>* Conveyance</li> <li>* Swabbing/Flushing</li> <li>* Sampling/Testing</li> <li>* QA/QC</li> <li>* Repair Inspection</li> <li>* Storage</li> <li>* Sources &amp; Characteristics</li> <li>* Compliance</li> <li>* Excavation &amp; Repair</li> <li>* Pressure Control</li> <li>* Temporary Service</li> <li>* Leak Detection</li> <li>* Metering</li> <li>* Disinfection - Repair</li> </ul> | <ul style="list-style-type: none"> <li>* Conveyance</li> <li>* Pressure Control</li> <li>* Storage</li> <li>* Swabbing/Flushing</li> <li>* QA/QC</li> <li>* Sampling/Testing</li> <li>* Compliance</li> <li>* Corrosion Control</li> <li>* Metering</li> <li>* Leak Detection</li> <li>* Well Operation/ Disinfection</li> <li>* Sources &amp; Characteristics</li> <li>* Temporary Service</li> <li>* Disinfection - Repair</li> <li>* Repair Inspection</li> </ul> | <ul style="list-style-type: none"> <li>* Pressure Control</li> <li>* Conveyance</li> <li>* Storage</li> <li>* QA/QC</li> <li>* Compliance</li> <li>* Leak Detection</li> <li>* Sampling/Testing</li> <li>* Swabbing/Flushing</li> <li>* Excavation &amp; Repair</li> <li>* Corrosion Control</li> <li>* Metering</li> <li>* Repair Inspection</li> </ul> |

## ENDNOTES: TOPIC DESCRIPTIONS

### **G**eneral Module

**T**he numbers below refer to the topics listed in the above table entitled “**Ontario Water Distribution Exam Detailed Topic Breakdown**” (pages 6-8). The below endnotes provide a greater description of the topic, by providing an indication of the equipment and processes involved.

- 1 **Basic and Applied Math** - Calculating volume, area, flow rates, feed rates, percentages, ratios, squares, cubes, roots, ability to calculate water/wastewater formulas.
- 2 **Units of Expression** - Imperial, metric, conversion between imperial and metric, common metric prefixes.
- 3 **Basic & Applied Science** - Chemistry (common water/wastewater chemicals, chemical reactions, basic chemistry terms: [pH and related concepts, oxidation/reduction, ionization etc], mixtures and solutions) physical properties of liquids, solids and gases.
- 4 **Public Health Principles** - Microbiology (pathogens, nuisance organisms), microbiological testing (coliform testing), drinking water quality parameters.
- 5 **Electrical Concepts** - Electrical units (volt, amperes, ohms, watts), electrical circuits, electrical terminology.
- 6 **Hydraulic Concepts** - Rate of flow, pressure, head (static, friction, pressure), pump hydraulics (work, power, horsepower, efficiency).
- 7 **Maps and Plans** - Maps, blue prints, site diagrams, plans, equipment specifications.
- 8 **Safety Procedures** - Occupational Health and Safety Act, WHMIS, owner/operator responsibilities, construction safety, plant safety, electrical safety, infections and infectious diseases, hazardous gases, chemical handling, chemical labels, confined space entry, excavation procedures.
- 9 **Safety Equipment** - Personal protection gear, traffic control/public safety (warning devices, barricades), hazard detection, first aid/hygiene, gas detection equipment

### **S**upport Systems Module

- 10 **Electrical Controls** - Electrical circuits, circuit testing, fuses, protective devices, circuit breakers, overload relays, motor starters.
- 11 **Motors** - Single Phase, Poly Phase, Variable Speed
- 12 **Drives** - Coupled, Direct (Shaft, Gear), Speed Reducer (Fixed, Variable), Right Angle
- 13 **Positive Displacement Pumps** - Piston Plunger, Progressive Cavity, Diaphragm
- 14 **Generators** - AC, DC

## **P**rocesses Module

- 15 **Engines** - Gasoline, Diesel, Gas
- 16 **Joints** - Flanged, Compression, Dresser, Victaulic, Fused, Threaded
- 17 **Valves** - Ball, Check, Globe, Gate, Plug Petcock, Pressure Control, Vacuum Relief, Aud, Butterfly, Multiport, Telescoping Sluice Gate, Air Release, Foot, Altitude
- 18 **Fittings** - Coupling Union, Plug/Caps, Special
- 19 **Cathodic Protection Devices** - Anode Rod/Bags, Cathode Rod/Bags, Rectifiers, Potentiometers
- 20 **Measuring and Control** - Signal Generators (Kennison Nozzle, Magnetic Flowmeter, Parshall Flume, Proportional Weir, Rectangular Weir, Venturi, Propeller Meter, Ultrasonic, Pitot Tube), Signal Transmitters (Electric, Pneumatic, Hydraulic, Mechanical, Telemetry), Signal Receivers (Counters, Indicators, Log Scale Indicators, Totalizers, Recorders, Combination Recorders), Meters (Hydraulic-Rotameter, Electrical-Amp, Electrical-Watt [Watt Hour Meter], Electrical-Multitester VOM), Electrical-Megger, Mechanical-RPM), Alarms, Controls (Pneumatic, Float, Hydraulic, Electrical, Telemetry, Timers)
- 21 **Sources & Characteristics** - Characteristics of ground and surface waters, seasonal and daily quality changes, seasonal and daily demands.
- 22 **Quality Control & Assurance (QA/QC)** - Indicators of water quality, quality control procedures.
- 23 **Compliance**- Ontario environmental legislation affecting water distribution plants, scope and authority of certificates of approval, owner/operator responsibilities.
- 24 **Conveyance** - Piping, valves, service connections, hydrants
- 25 **Pressure Control** - Booster pumps, regulator stations, gauges, pressure testing.
- 26 **Storage**- Surge tanks, elevated tanks, ground tanks, standpipes, hydropneumatic pressure tanks
- 27 **Corrosion Control** - Pipe corrosion characteristics, coatings (metallic and non-metallic), chemical treatment (cathodic protection is covered in the support systems module above)
- 28 **Metering** - Displacement meters, velocity meters, differential meters
- 29 **Leak Detection** - Sonic devices, pressure devices, volume leak detection, visual detection.
- 30 **Excavation & Repair** - Excavation, shoring,
- 31 **Repair Inspection** - Inspection of repaired or new watermain to ensure potable water; inspection criteria, superchlorination requirements, Certificate of Approval requirements, sampling/testing requirements, quality assurance

## **P**rocesses Module

- 32 **Temporary Service** - Provision of potable water in emergencies, watermain bypass
- 33 **Fire Flow** - Operating procedures during a serious fire
- 34 **Well Operation** - Basic well components and definitions, well operation, controls
- 35 **Disinfection - Wells** - Hypochlorinators, gas chlorinators
- 36 **Disinfection - Pipe Repair** - Water main disinfection (chlorination - continuous feed, slug or tablet)
- 37 **Thawing** - Electrical, steam and hot water
- 38 **Sampling** - Sample location, sampling technique, test interpretation
- 39 **Testing** - Tests routinely conducted on site by operators, often using portable equipment. Includes chlorine residual, pH and temperature
- 40 **Planning** - Facility planning, decision making.
- 41 **Personnel** - Supervision/management, hiring, disciplining, interviews, communication,
- 42 **Finances** - Budgets, procurement, purchasing, inventory control/management.
- 43 **Maintenance Management** - Maintenance procedures (general),
- 44 **Information** - Record keeping, computer systems, reports.
- 45 **Emergency Response** - Spill response, fire, explosion, bomb threat, natural emergencies, hydraulic overload, slug loads, process failure.
- 46 **Public Relations** - Communication with public, complaint investigation, disclosure of information.
- 47 **Security** - Security of facility and property, prevention of vandalism, theft, security of staff, security of product.

## TASK ANALYSIS

### **G**eneral Module



he listing below provides more detail on the types and level of knowledge required for each of the topics for each Class of exam.

A. Operator must complete the following performance objectives as indicated:

### **Basic and Applied Math (Topic 101)**

#### **Basic & Intermediate Tasks**

- 1.1 Perform addition, subtraction, multiplication and division of whole numbers and decimals
- 1.2 Square and cube whole numbers, proper fractions, improper fractions, mixed numbers and decimals
- 1.3 Using conventional formulas, calculate area of rectangles, triangles, and circles; surface area and volume of cylinders, cones, and spheres

#### **Advanced Tasks - Basic tasks plus:**

- 1.4 Convert fractions to percentage and vice-versa
- 1.5 Plot and interpret graphs, including line, bar, percentage, and broken line
- 1.6 Develop and read tables
- 1.7 Using conventional formulas, solve for direct and inverse proportions
- 1.8 Using conversion reference, convert from English to metric and vice-versa
- 1.9 Calculate percent removal
- 1.10 Interpret word problems, obtaining the required values and formulas
- 1.11 Use standard water/wastewater formulas

### **Units of Expression (Topic 102)**

#### **Basic, Intermediate & Advanced Tasks:**

- 2.1 Define terms of expression, such as ppm, mg/L, MG/d
- 2.2 Convert from one unit to another using appropriate references or formulas; convert from imperial to metric units

### **Basic and Applied Science (Topic 111)**

#### **Basic Tasks:**

- 3.1 Define concepts in basic chemistry
- 3.2 Identify and describe chemicals used in water distribution
- 3.3 Define and describe the significance of basic concepts in water chemistry
- 3.4 Define and describe the significance of basic concepts in microbiology, including viruses, bacteria, and algae

**Intermediate Tasks - Basic tasks plus:**

- 3.5 Explain the factors which effect the safety of drinking water
- 3.6 Explain remedial measures which can ensure safe drinking water

**Advanced Tasks - Basic and Intermediate tasks plus:**

- 3.7 Describe and explain the significance of common chemical reactions in water distribution

**Public Health Principles (Topic 112)****Basic & Intermediate Tasks:**

- 4.1 Describe public health principles, laws, and regulations
- 4.2 Identify common pathogens within raw water

**Advanced Tasks - Basic and Intermediate tasks plus:**

- 4.3 Identify common chemicals contained in raw water and their effect on human health
- 4.4 Identify the control methods to eliminate the spread of pathogens

**Electrical Concepts (Topic 113)****Basic Tasks:**

- 5.1 Identify the basic electrical units and explain their meaning
- 5.2 Identify the safety requirements when working on electrical equipment
- 5.3 Using basic electrical concepts explain the safety hazards associated with electricity

**Intermediate Tasks - Basic tasks plus:**

- 5.4 Identify the types of electrical circuits found in water facilities.

**Advanced Tasks - Basic and Intermediate tasks plus:**

- 5.5 Explain the basic principles of common electrical circuits
- 5.6 Identify the electrical requirements of different types of equipment

**Hydraulic Concepts (Topic 114)****Basic Tasks:**

- 6.1 Define basic hydraulic concepts (head, pressure, rate of flow).
- 6.2 Explain the movement and properties of liquid under pressure.

## **S**upport Systems Module

A: Perform operating procedures associated with the normal and abnormal conditions for support systems/equipment

### **Intermediate Tasks - Basic tasks plus:**

- 6.3 Calculate pumping head, pressure head, static head
- 6.4 Using hydraulic concepts and terms explain how a pump functions

### **Advanced Tasks - Basic and Intermediate tasks plus:**

- 6.5 Describe the relationship between pumping head, horsepower and pump efficiency
- 6.6 Calculate horsepower and pumping efficiencies
- 6.7 Understand the basic hydraulic principles behind common flow measurement devices

## **Maps and Plans (Topic 115)**

### **Basic Tasks:**

- 7.1 Interpret and use maps and plans

### **Intermediate and Advanced Tasks - Basic tasks plus:**

- 7.2 Calculate grades and changes in elevation

## **Safety Procedures and Equipment (Topic 121/122)**

### **Basic, Intermediate & Advanced Tasks:**

- 8.1 Identify basic categories of safety hazards
- 8.2 Identify basic safety procedures
- 8.3 Identify violations of personal hygiene
- 8.4 Describe personal safety procedures
- 8.5 Describe fire safety procedures
- 8.6 Describe chemical safety procedures
- 8.7 Describe confined space safety procedures
- 8.8 Describe safe excavation procedures

## **Support Systems Modules (Topics 201-213)**

### **Basic Tasks**

- 9.1 Identify safety hazards and correct safety procedures
- 9.2 Perform necessary calculations
- 9.3 Record necessary information
- 9.4 Describe purpose of system/equipment/components
- 9.5 Relate necessary information to others

### **Intermediate Tasks - Basic tasks plus**

- 9.6 Recognize indicators of normal and abnormal conditions
- 9.7 Perform actions at appropriate time, location and frequency
- 9.8 Use necessary tools/test equipment/reference manuals

|                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|-------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                   | <p><b>Advanced Tasks - Intermediate tasks plus</b></p> <p>9.9 Identify causes of abnormal conditions using proper troubleshooting techniques</p> <p>9.10 Explain reasons for taking these actions, including consequences of not taking action</p> <p>9.11 Explain interaction with other support systems/equipment and the total treatment process</p> <p>9.12 Identify the applicable standards imposed by process parameters, laws, and regulators</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <p>B. Perform start-up/shut-down procedures on support systems/equipment</p> <hr/> <p><b>P</b>rocesses Module</p> | <p><b>Basic Tasks</b></p> <p>10.1 Identify safety hazards</p> <p>10.2 Identify correct safety procedures</p> <p>10.3 Perform necessary calculations</p> <p>10.4 Record necessary information</p> <p>10.5 Relate necessary information to others</p> <p><b>Intermediate Tasks - Basic tasks plus</b></p> <p>10.6 Identify conditions requiring start-up/shut-down of the support system/equipment</p> <p>10.7 Perform necessary actions at appropriate the, location and frequency</p> <p>10.8 Use necessary tools/test equipment/reference manuals</p> <p><b>Advanced Tasks - Intermediate tasks plus</b></p> <p>10.9 Explain reasons for taking these actions including consequences of not taking action</p> <p>10.10 Explain interaction with other support systems/equipment and the total treatment process</p> <p>10.11 Identify the applicable standards imposed by process parameters, laws, and regulations</p> |
| <p>A. Operator must complete the following performance objectives as indicated:</p> <hr/>                         | <p><b><u>Sources and Characteristics (Topic 301)</u></b></p> <p><b>Basic &amp; Intermediate Tasks</b></p> <p>11.1 Identify raw water sources</p> <p>11.2 Describe source quality and quantity</p> <p><b>Advanced Tasks - Intermediate tasks plus:</b></p> <p>11.3 Identify physical, chemical, and biological characteristics</p> <p>11.4 Describe basic principles in well operation</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |

## **Quality Control and Assurance (Topic 302)**

### **Basic, Intermediate & Advanced Tasks:**

- 12.1 Perform quality control and assurance procedures
- 12.2 Identify quality control indicators

## **Compliance (Topic 303)**

### **Basic, Intermediate & Advanced Tasks:**

- 13.1 List the relevant regulations, acts and other legal documents
- 13.2 Perform all tasks in compliance with legislation and Certificates of Approval
- 13.3 List the common Ontario Drinking Water Objectives

B. Perform operating procedures associated with normal and abnormal conditions for processes/units

## **Unit Processes (Topics 304 - 321)**

### **Basic Tasks**

- 14.1 Identify safety hazards and correct safety procedures
- 14.2 Perform necessary calculations
- 14.3 Record necessary information
- 14.4 Sketch and describe each element
- 14.5 Describe purpose of the process/units/components
- 14.6 Relate necessary information to others

### **Intermediate Tasks - Basic tasks plus**

- 14.7 Recognize indicators of normal and abnormal conditions
- 14.8 Perform necessary actions at appropriate the location and frequency
- 14.9 Use necessary tools / test equipment/reference manuals

### **Advanced Tasks - Intermediate tasks plus**

- 14.10 Identify causes of abnormal conditions using proper trouble shooting techniques
- 14.11 Explain reasons for taking these actions, including consequences of not taking action
- 14.12 Explain interaction with other processes/units and the total treatment process
- 14.13 Identify the applicable standards imposed by process parameters, legislation and Certificate of Approval

C. Perform start-up/shut-down procedures on processes/units

### **Basic Tasks**

- 15.1 Identify safety hazards/safety procedures
- 15.2 Perform necessary calculations
- 15.3 Record and relate necessary information to others

**Intermediate Tasks - Basic tasks plus**

- 15.4 Identify conditions requiring start-up/shut-down of the process/unit
- 15.5 Perform necessary actions at the appropriate location and frequency
- 15.6 Use necessary tools/ test equipment/reference manuals

**Advanced Tasks - Intermediate tasks plus**

- 15.7 Explain reasons for taking these actions, including consequences of not taking action
- 15.8 Explain interaction with other processes/units and the total treatment process
- 15.9 Identify applicable standards imposed by process parameters, legislation and Certificate of Approval

D. Perform repair and installation procedures for distribution system components and processes

**Basic Tasks**

- 16.1 Identify safety hazards
- 16.2 Identify correct safety procedures
- 16.3 Perform necessary calculations
- 16.4 Record necessary information

**Intermediate Tasks - Basic tasks plus**

- 16.5 Perform actions at appropriate time, location and frequency
- 16.6 Use necessary tools/test equipment/reference manuals

**Advanced Tasks - Intermediate tasks plus**

- 16.7 Interpret plans specifications, and other references
- 16.8 Explain reasons for taking these actions including consequences of not taking action
- 16.9 Explain interaction with other processes/unit and the total treatment process
- 16.10 Identify applicable standards imposed by process parameters, legislation and Certificate of Approval
- 16.11 Perform inspection procedures

E. Operator must complete the following performance objectives as indicated:

**Sampling (Topic 320)****Basic Tasks:**

- 17.1 Interpret chemical labels and standard shipping label of chemicals
- 17.2 Label containers
- 17.3 Take samples using proper procedures
- 17.4 Transport samples using proper procedures
- 17.5 Store samples using proper procedures

- 17.6 Identify safety hazards and correct safety procedures
- 17.7 Perform necessary calculations
- 17.8 Record necessary information on all required logs/reports
- 17.9 Relate necessary information to others

**Intermediate Tasks - Basic tasks plus:**

- 17.10 Prepare sample containers using proper procedures
- 17.11 Specify time and frequency for taking samples
- 17.12 Select sample location using proper procedures
- 17.13 Interpret test results
- 17.14 Describe purpose of test/procedure

**Advanced Tasks - Basic and Intermediate tasks plus:**

- 17.15 Make appropriate decision(s) concerning results which indicate abnormal conditions
- 17.16 Explain reasons for using proper procedures and the consequences of not using these procedures
- 17.17 Identify applicable standards imposed by system parameters, legislation and Certificate of Approval

**Testing (Topic 321)**

**Basic Tasks:**

- 18.1 Label containers
- 18.2 Take samples using proper procedures
- 18.3 Transport samples using proper procedures
- 18.4 Store samples using proper procedures
- 18.5 Identify safety hazards and correct safety procedures
- 18.6 Perform necessary calculations
- 18.7 Record necessary information on all required logs/reports
- 18.8 Relate all necessary information to others

**Intermediate Tasks - Basic tasks plus:**

- 18.9 Prepare sample containers using proper procedures
- 18.10 Specify time and frequency for taking samples
- 18.11 Select sample location using proper procedures
- 18.12 Conduct test procedures using proper procedures and equipment
- 18.13 Interpret test results
- 18.14 Describe purpose of test/procedure

**Advanced Tasks - Basic and Intermediate tasks plus:**

- 18.15 Make appropriate decision(s) concerning results which indicate abnormal conditions
- 18.16 Identify applicable standards imposed by system parameters, legislation and Certification of Approval

## **A** dministration Module

A. Operator must complete the following performance objectives as indicated:

### **Management (Topics 411-413)**

#### **Basic Tasks:**

- 19.1 Perform necessary financial calculation (basic budget, accounts payable, calculation of unit costs)
- 19.2 Describe the importance of documenting meetings, management decisions, dealing with staff
- 19.3 Describe the purpose of good management practices
- 19.4 Describe the elements of an effective office communication strategy
- 19.5 Define and use basic financial/purchasing terms and concepts
- 19.6 Define and differentiate basic management/supervisory terms and concepts
- 19.7 Describe the components of a short/long term plan

#### **Intermediate Tasks - Basic tasks plus:**

- 19.8 Recognize indicators of good/poor management practices
- 19.9 Relate management strategies/plans to others within the distribution system
- 19.10 Evaluate the effectiveness of master plans for meeting distribution system objectives
- 19.11 Describe good task coordination and delegation techniques/methods

#### **Advanced Tasks - Basic and Intermediate tasks plus:**

- 19.12 Differentiate between appropriate and inappropriate actions with subordinates and the consequences of each
- 19.13 Explain the interaction of different management practices
- 19.14 Set system objectives based upon distribution system performance and resources
- 19.15 Set goals, overall objectives and identify methods to obtain goals/objectives
- 19.16 Develop master plan which includes objectives (short and long term), strategies, financial support, presentation to key personnel
- 19.17 Prepare management practices to implement master plan objectives
- 19.18 Implement management practices to accomplish master plan objectives
- 19.19 Evaluate the effectiveness of master plans and management practices

## **Administration (Topics 421-425)**

### **Basic Tasks:**

- 20.1 Take appropriate action to maintain distribution system security
- 20.2 Record necessary information, complete logs, write necessary reports, and identify the purpose for maintaining these records
- 20.3 Use necessary reference materials
- 20.4 Communicate effectively with the public
- 20.5 Describe appropriate actions which should be completed during various types of emergency situations
- 20.6 Explain the purpose of an effective maintenance management system
- 20.7 Describe routine maintenance procedures for common distribution system processes

### **Intermediate Tasks - Basic tasks plus:**

- 20.8 Develop an effective public relations policy
- 20.9 Develop an effective maintenance management program
- 20.10 Perform necessary actions (reporting, maintenance management, planning) at appropriate time, location and frequency

### **Advanced Tasks - Intermediate and Basic tasks plus:**

- 20.11 Conform with all legislation and Certificates of Approval during a spill or other emergency



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